HYDROGEOLOGICAL STUDIES FOR THE SANDY RIDGE PROJECT

DRILLING, PERMEABILITY TESTING AND POTENTIAL WATER SOURCES REPORT

REPORT FOR TELLUS HOLDINGS

AUGUST 2015
TABLE OF CONTENTS

1 INTRODUCTION 1
  1.1 Previous Investigations 1
2 METHODOLOGY 2
  2.1 Drilling and Monitoring Bore Construction 2
  2.2 Monitoring Bore Permeability Tests 3
3 RESULTS 3
  3.1 Geology 3
  3.2 Hydrogeology 5
  3.3 Monitoring Bore Permeability Tests 6
4 WATER SUPPLY ASSESSMENT 7
5 CONCLUSIONS 8
REFERENCES 9

Tables
Table 1: Monitoring Bore Construction Details 4
Table 2: Results of Permeability Testing, Monitoring Bores 7

Figures
1 Project Location
2 Bore Locations
3 General Construction Diagram for Monitoring Bores
4 Ground-Surface Topography, & Elevation of Weathered Granite
5 Wet and Dry Drillhole Locations
6 Elevation (m AHD) Base of Kaolinite, and Damp Zones
7 Potential Water Sources

Appendices
I Bore Completion Data
II Permeability Test Plots and Calculations

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<th>REVIEW</th>
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1 INTRODUCTION

Tellus Holdings Limited (Tellus) is proposing to develop a kaolin mine at its Sandy Ridge project at Mount Walton, approximately 140 km north-west of Kalgoorlie (Fig. 1). It plans to utilise mined-out pits for a complementary storage and waste disposal business.

Rockwater was engaged to make an assessment of the hydrogeology and hydrology of the project area. The hydrogeological assessment is to include the characteristics of any groundwater at the site, and a desk-top study of potential water sources for the project. A water supply of about 120 kL/d will be needed for processing the kaolinite, plus water for dust suppression and compaction (possibly about 495 kL/d in total).

This report includes:

1. The results of a desk-top study of the hydrogeology of the project area;
2. The results of drilling, monitoring bore construction and permeability testing conducted in March 2015;
3. The characteristics of groundwater at the site; and
4. A desk-top study of potential water sources for the project.

The surface water study results and the protection required for mine pits are covered in a separate report.

1.1 PREVIOUS INVESTIGATIONS

Hirschberg (1988) conducted a hydrogeological reconnaissance of Mt Walton Northeast Area A which included the area now used for the Mt Walton waste facility, and Sandy Ridge, and found the area to be generally suitable for the disposal of hazardous wastes, but recommended drilling to prove it up. Marcos (1988) made a preliminary appraisal of the same area from a geotechnical perspective, although that report has not been reviewed for this report.

Soil & Rock Engineering (1989) conducted a geotechnical investigation of the Mt Walton waste facility site. Four holes were drilled by coring techniques, and eight holes were drilled using air-hammer and air-core methods. No groundwater indications were obtained from the first four holes, as mud was used for circulation. The other holes intersected sand to depths of up to 1.5 m, overlying gravel to depths of up to 2.6 m, and then weathered to fresh granite. They were all dry. Permeability tests conducted on four of the air-core holes gave approximate permeabilities of the weathered granite ranging from $2.5 \times 10^{-8}$ m/sec to $3.2 \times 10^{-7}$ m/sec.
ATA (1995) conducted a drilling programme at Mt Walton, as well as an additional nine holes on a 1.8 km grid in a 25 km² area to the north-west that includes the Sandy Ridge project area. Sandy Ridge lies within the central to south-western part of the ATA grid. No groundwater was intersected in the ATA holes, although some dampness was recorded in the south-western-most hole (No. 61) of those in the western (Sandy Ridge) area (Fig. 2). The holes in the western area had depths to basement of 20.5 m to 44 m, and kaolinite thicknesses of 11 m to 38 m.

The Department of Water WIR database was checked for any bore data in the Sandy Ridge region. There are none (other than investigation holes at the Mt Walton site) – the nearest are water-supply bores constructed at sites selected by Rockwater for the Mt Dimer gold mine, 23 km or more to the west.

The Sandy Ridge site is in an area characterised by Kern (1994) as weathered granitoid rock with minor groundwater resources.

2 METHODOLOGY

2.1 DRILLING AND MONITORING BORE CONSTRUCTION

Investigation holes/monitoring bores were drilled and constructed at seven sites in the project area (Fig. 2) to depths in the range 21 to 49 m below ground level (bgl). They were completed by Wallis Drilling on the 14 and 15 April using a Mantus 300 drilling rig and reverse-circulation air-core and air-hammer drilling techniques at a diameter of 152 mm.

All sites were within the planned mining area, except for bore SRMB150 which is located close to the western boundary. Bores SRMB150 to 152) targeted an area where the fresh granite was known to be deep and so it was more likely that groundwater would be intersected.

The air-core drilling method resulted in very slow penetration rates or bit refusal through hard silcrete layers. These hard layers were typically intersected around 8 m below the surface. Also, the sampling cyclone was prone to blockage in drilling the silcrete. Where possible, air-core methods were used to drill the entire hole, otherwise air-hammer techniques were used through the silcrete before switching back to an air-core bit. For more details on drilling methods for each bore see Appendix I.

The holes were continued until bit refusal with air-core methods, in weathered or fresh granite, and were geologically logged.
All the holes were cased with 55 mm ID, 61 mm OD, Class 9 blank and slotted PVC casing (1 mm aperture) as monitoring bores. Surface casing consisted of 127 mm ID, 145 mm OD steel casing. The annuli of slotted sections of the bores were packed with 1.6 to 3.2 mm graded gravel with a 4 m bentonite seal installed above the gravel pack. Above the bentonite, the annuli were back-filled to the surface with drill cuttings, and a 150 mm ND galvanised bore cover with lockable lid was set in place (with concrete) to protect the bores at the surface. Bore construction details are summarised in Table 1 (Page 4) and details are included in Appendix I. The bore design is shown in Figure 3.

2.2 MONITORING BORE PERMEABILITY TESTS

Falling-head permeability tests were conducted on each of the seven monitoring bores. A slug of water (9 L or 18 L) was poured into the uPVC casing of each bore, and water-level recession was monitored using manual measurements and a pressure transducer/data logger.

In the four bores where no water was intersected (SRMB 146, 147, 148 and 149), kaolinite or highly weathered granite was being tested. Where water was intersected (SRMB150 to 152) the transition zone (weathered granite) was being tested.

The data for bores SRMB 146, 147, 148 and 149 were analysed using the method of Oosterbaan and Nijland (1994) for calculating permeability (hydraulic conductivity) of material above the water table; and the Bouwer and Rice (1976) method was used for bores SRMB150 to 152 where the water table was intersected.

3 RESULTS

3.1 GEOLOGY

All seven holes intersected a typical granite weathering profile with generally 2 to 3 m of surficial aeolian sand overlying up to 8 m of silcreted clay and/or laterite, then mottled and pallid zone clays/very deeply to completely weathered granite; with slightly weathered to fresh granite at depth in the deep holes and from 26 to 31 m depth in SRMB146. Geological logs are included with the bore completion data in Appendix I.

Minor vugs were noted in the silcrete, clay, kaolinite and weathered granite. An example is shown in the photograph in Page 5, below.

Geological sections prepared for Tellus by Terra Search, and the results of this drilling, show that the top of the moderately weathered to fresh granite is generally at lower elevations to the west and north of the project area (Fig. 4).
Table 1: Monitoring Bore Construction Details

<table>
<thead>
<tr>
<th>Bore</th>
<th>Const. Date</th>
<th>Easting (mE)</th>
<th>Northing (mN)</th>
<th>RLGL (DTM) (mAHd)</th>
<th>Casing Depth (mbtoc)</th>
<th>Casing Material</th>
<th>Casing I.D. (mm)</th>
<th>PVC (magl)²</th>
<th>Steel (magl)²</th>
<th>Slotted Interval (mbgl)²</th>
<th>Water Level</th>
<th>Airlift Yield (L/s)</th>
<th>Salinity² (mg/L TDS)</th>
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<tr>
<td>SRMB146</td>
<td>16/03/15</td>
<td>219888</td>
<td>6637794</td>
<td>466.8</td>
<td>30.5</td>
<td>PVC</td>
<td>55</td>
<td>0.66</td>
<td>0.88</td>
<td>24.5-30.5</td>
<td>wet at base</td>
<td>dry</td>
<td>n/a</td>
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<td>SRMB147</td>
<td>16/03/15</td>
<td>219890</td>
<td>6638007</td>
<td>465.7</td>
<td>20.6</td>
<td>PVC</td>
<td>55</td>
<td>0.88</td>
<td>0.88</td>
<td>14.6-20.6</td>
<td>wet at base</td>
<td>dry</td>
<td>n/a</td>
</tr>
<tr>
<td>SRMB148</td>
<td>16/03/15</td>
<td>219702</td>
<td>6637808</td>
<td>463.9</td>
<td>24.3</td>
<td>PVC</td>
<td>55</td>
<td>0.89</td>
<td>1.00</td>
<td>18.3-24.3</td>
<td>wet at base</td>
<td>dry</td>
<td>23.82</td>
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<td>220238</td>
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<td>PVC</td>
<td>55</td>
<td>1.06</td>
<td>1.15</td>
<td>16.9-22.9</td>
<td>wet at base</td>
<td>dry</td>
<td>n/a</td>
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<tr>
<td>SRMB150</td>
<td>17/03/15</td>
<td>219372</td>
<td>6638392</td>
<td>463.9</td>
<td>49.0</td>
<td>PVC</td>
<td>55</td>
<td>0.92</td>
<td>1.07</td>
<td>40.0-49.0</td>
<td>36.10</td>
<td>35.92</td>
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<tr>
<td>SRMB151</td>
<td>17/03/15</td>
<td>219681</td>
<td>6638402</td>
<td>465.3</td>
<td>44.7</td>
<td>PVC</td>
<td>55</td>
<td>0.58</td>
<td>0.58</td>
<td>38.7-44.7</td>
<td>mud at base? dumb at base</td>
<td>moist at 36m, nil</td>
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<td>219499</td>
<td>6637606</td>
<td>464.1</td>
<td>38.4</td>
<td>PVC</td>
<td>55</td>
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<td>0.54</td>
<td>32.4-38.4</td>
<td>34.35</td>
<td>34.14</td>
<td>34.22</td>
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Airlift yield from open hole

Salinity as TDS calculated from field EC (electrical conductivity)

m btoc = metres below top of casing, steel

m agl = metres above ground level

m bgl = metres below ground level
3.2 HYDROGEOLOGY

Four of the bores (SRMB146 to 149) were dry when drilled, and two remained dry when sounded in May 2015 (Table 1). The other two bores (SRMB146 and 147) had a thin layer of water in their bases, as did all four bores in July and October 2015 – at levels well above that of the water table in the deep bores. The water is residual water that remains following the falling-head permeability tests and/or very minor seepage water.

Very small quantities of groundwater were airlifted from bores SRMB150 (~0.03 L/s) and SRMB152 (<0.01 L/s) when they were drilled, and those two bores and SRMB151 contained groundwater when they were sounded in May to October 2015. The static water levels on 6 May 2015 were 34.4 to 36.7 mbtoc (below the top of the casings), and at elevations of 428.9 to 430.3 m AHD. Water levels in the bores were 0.13 to 0.21 m higher on 30 July than on 6 May even though there had been no significant rainfalls between the two monitoring events, and it is likely that the higher levels on 30 July resulted from continuing slow water-level recovery following bore construction, or low barometric pressures prior to a major rainfall event on 31 July and 1 August: 69 mm fell at Koolyanobbing on those two days. Water levels on 19 October were recorded at
34.2 mbtoc (bore SRMB152) and 36 mbtoc (bore SRMB150), similar to levels recorded in July 2015.

The water from bores SRMB150 and 152 is saline, with salinities of 6,570 and 6,030 mg/L TDS (total dissolved solids), respectively.

All three bores that intersected groundwater had a water level at a depth lower than the planned excavation depth of 30 m. Bore SRMB150 had the shallowest water level (34.23 mbtoc) on 6 May 2015, this bore is located outside of the mining area. The low airlift yields and low permeabilities (Section 3.3) show that the zones containing the groundwater do not constitute an aquifer.

Assuming the groundwater levels have reached near equilibrium (static) levels, they indicate that the groundwater flows to the north-west under a low hydraulic gradient.

All of the kaolinite exploration holes drilled by Tellus were dry. Five of them intersected some damp kaolinite/weathered granite in the planned mining area (Fig. 5). One of those two holes (the southern-most) intersected a damp zone above the base of the kaolinite (Fig. 6).

In summary, only negligible groundwater has been intersected in the planned mining area, at a depth below the planned excavations, and only one hole in the south-western part of that area intersected damp kaolinite.

### 3.3 MONITORING BORE PERMEABILITY TESTS

The falling-head test data were analysed using the method of Bouwer and Rice (1976) for those bores that intersected the water table (SRMB150 to 152); and Oosterbaan and Nijland (1994) for the dry bores (SRMB146 to 149) to determine permeability (hydraulic conductivity). Plots and calculations are given in Appendix II and the results are summarised in Table 2.

The hydraulic conductivities ranged from 0.02 to 0.99 m/day. Those calculated using the Oosterbaan and Nijland (1994) method (SRMB146 to 149) should be considered as first estimates only, as the method assumes that material in the test interval is saturated prior to testing. In reality the material was not saturated, and so the hydraulic conductivities obtained are probably higher than the true values. The values from the tests on SRMB150 to 152 – analysed by the Bouwer and Rice method – ranged from 0.02 to 0.33 m/d. These low to moderately low values are in the range of values commonly assigned to clayey/silty sand.
### 4 WATER SUPPLY ASSESSMENT

A water supply of 180,000 kL per annum (~495 kL/d or about 6 L/s) will be required when mining and mineral processing is ramped-up to full production. Initially a much smaller volume would be required.

There are two untested areas with good potential for obtaining saline groundwater supplies, although neither is close to the project. One is 12 to 15 km to the south-west and south of Sandy Ridge on tenements held by Polaris Metals where several south-westerly trending drainage lines cross a chert ridge in the Yendilberin Hills (Fig. 7). These drainages appear to be following cross-cutting faults. The other is a probable palaeochannel aquifer, 16 km to the east of Sandy Ridge that is interpreted to follow a north-south chain of saline playas. It is covered by a Miscellaneous Licence held by Norilsk Nickel.

Groundwater in both areas is expected to be saline: about 20,000 mg/L TDS in the south-western area, and possibly around 100,000 mg/L TDS in the eastern area.

The most practical source of water for the project is probably the Carina iron ore mine owned by Polaris Metals Pty Ltd. The Carina mine is located 12 km south-west of Sandy Ridge in the Yendilberin Hills. The hills are a narrow, approximately north-west- to south-east-trending rocky ridge composed principally of banded chert and ferruginous banded chert with minor BIF and quartzite (Fig. 7).

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### Table 2: Results of Permeability Testing, Monitoring Bores

<table>
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<tr>
<th>Bore</th>
<th>Test No.</th>
<th>KH (m/d)</th>
<th>KH (m/s)</th>
<th>Lithology of screened Interval</th>
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<tr>
<td>SRMB146</td>
<td>1</td>
<td>0.14</td>
<td>1.62E-06</td>
<td>Kaolinite, &amp; deeply weathered granite</td>
</tr>
<tr>
<td>SRMB146</td>
<td>2</td>
<td>0.12</td>
<td>1.39E-06</td>
<td></td>
</tr>
<tr>
<td>SRMB147</td>
<td>1</td>
<td>0.93</td>
<td>1.08E-05</td>
<td>Kaolinite (saprolite)</td>
</tr>
<tr>
<td>SRMB148</td>
<td>1</td>
<td>0.99</td>
<td>1.15E-05</td>
<td>Kaolinite (weathered granite)</td>
</tr>
<tr>
<td>SRMB149</td>
<td>1</td>
<td>0.39</td>
<td>4.51E-06</td>
<td>Weathered granite</td>
</tr>
<tr>
<td>SRMB149</td>
<td>2</td>
<td>0.22</td>
<td>2.55E-06</td>
<td></td>
</tr>
<tr>
<td>SRMB150</td>
<td>1</td>
<td>0.03</td>
<td>3.47E-07</td>
<td>Weathered &amp; fresh granite</td>
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<tr>
<td>SRMB150</td>
<td>2</td>
<td>0.02</td>
<td>2.31E-07</td>
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</tr>
<tr>
<td>SRMB151</td>
<td>1</td>
<td>0.33</td>
<td>3.82E-06</td>
<td>Mod. to slightly weathered granite</td>
</tr>
<tr>
<td>SRMB152</td>
<td>1</td>
<td>0.19</td>
<td>2.20E-06</td>
<td>Weathered granite</td>
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<tr>
<td>SRMB152</td>
<td>2</td>
<td>0.18</td>
<td>2.08E-06</td>
<td></td>
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*KH = hydraulic conductivity (horizontal) = permeability.
At Carina the goethite-hematite orebody constitutes the main aquifer. The ore is known to be highly vuggy and locally cavernous with a correspondingly high permeability. The adjoining mafic rocks appear to be relatively unfractured and, excluding the contact zones between the BIF and country rock which are often highly permeable groundwater conduits, only minor aquifers exist outside of the major ore-body aquifer.

The water at Carina has salinity of about 33,000 mg/L TDS (similar to seawater). If used for dust suppression the application of water will need to be carefully controlled to prevent runoff or over-spray into vegetated areas.

Based on climatic records from Kalgoorlie, the long-term average potential evaporation of the area is about 2,650 mm, with evaporation greatly exceeding rainfall during every month of the year. Groundwater recharge is therefore limited, probably being restricted to more-intense, short-term rainfall events when rainfall exceeds evaporation.

Prior to the commencement of mining at Carina, groundwater levels ranged from 40 to 70 m below ground level, depending on ground elevation. Mine dewatering commenced in mid-2011, and pumping rates in 2014/15 have averaged about 2,000 kL/d, and are expected to increase to around 3,000 kL/d. The water is currently stored in a series of turkeys nest dams and is used for dust suppression, ore processing and camp use. An unknown quantity is evaporated or lost as seepage back into the ground.

The volume of water required by Tellus for the Sandy Ridge project (180,000 kL/a) represents only a small fraction of the quantity being pumped and should be readily available from the Carina mine, and would reduce the quantity of water lost by evaporation and seepage by a similar amount. The impact of the usage by Tellus would, therefore, be negligible.

The nearest groundwater licence (GWL) to the Carina mine groundwater licence (GWL 177188) is GWL166014 held by Rob Hoppmann Mining Pty Ltd, 10 km to the north-north-west, for 200 kL/a. It is highly unlikely that utilising the excess water from Carina mine will have any impact on GWL166014 which is across-strike in a different stratigraphic unit.

5 CONCLUSIONS

The Sandy Ridge project is in an area underlain by granitic rocks where there is a thick weathering profile. Little or no groundwater has been intersected within the project area, in either the mineral exploration drilling or the 2015 investigation programme conducted by Rockwater. One mineral exploration hole intersected damp kaolinite within the planned mining area.
Three holes located in areas of greater depth to fresh granite, in the west and south-western parts of the project area, intersected small quantities of moderately saline groundwater (6,000 to 7,000 mg/L TDS). Airlift water yields ranged from zero to about 0.03 L/s, and permeabilities of the water-bearing zones were low, showing they do not constitute an aquifer.

The kaolinite and weathered granite are indicated to be of low to moderately low permeability (0.02 to 0.99 m/d, or 2.3E-07 to 1.2E-05 m/s). Permeability values for the dry holes should be taken as first estimates and are probably higher than actual values, because of limitations of the test method.

The most practical source of water for the project is probably the Carina iron ore mine, located 12 km south-west of Sandy Ridge in the Yendilberin Hills, where there is abundant water available from the pit and/or dewatering bores (up to 3,000 kL/d). The water has a salinity of about 33,000 mg/L TDS. It is highly unlikely that accessing water from Carina mine will have any additional impact at Carina because the volume sought is small and will replace water that is currently lost by evaporation and seepage. Also, the mine is remote (at least 10 km) from other groundwater users (except Polaris Metals).

Dated: 3 November 2015

Rockwater Pty Ltd

P H Wharton
Principal

R Wroe
Project Hydrogeologist

REFERENCES

ATA, 1995, Geological investigation of the intractable waste disposal facility, Mount Walton, Western Australia. Report to Waste Management Division of Dept. of Environmental Protection.


Soil & Rock Engineering (1989), Geotechnical studies Mt Walton. Report to Health Department of W.A.
FIGURES
CLIENT: Tellus Holdings
PROJECT: Sandy Ridge
DATE: October 2015
Dwg. No: 454-0/15/01-1
Air-hammer 191 mm diameter or 152 mm air-core hole

145 mm OD, 127 mm ID inner steel surface casing

61 mm OD, 55 mm ID, Class 9 uPVC blank casing

61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots, uPVC end cap

Gravel pack, graded 1.6 - 3.2, (from base of slots to ~5m above slots)

Bentonite seal (~4m)

Cement surface seal

150 mm ND galvanised bore cover with lockable lid

Natural backfill

Depth in the range 21 to 49 m bgs

CLIENT: Tellus Holdings
PROJECT: Sandy Ridge
DATE: June 2015
Dwg. No: 454.0/15/01-3

GENERAL CONSTRUCTION DIAGRAM
FOR MONITORING BORES
CLIENT: Tellus Holdings

PROJECT: Sandy Ridge

DATE: October 2015

Dwg. No: 454-0/15/01-4

GROUND-SURFACE TOPOGRAPHY, & ELEVATION
OF TOP OF WEATHERED GRANITE

Figure 4
Figure 6

Contours: Base of Kaolinite

- 439.9 Elevation, top of damp zone
- 433.9 Elevation, base of damp zone
- 440 Contours: Base of Kaolinite
- Pit Cells

CLIENT: Tellus Holdings
PROJECT: Sandy Ridge
DATE: October 2015
Dwg. No: 454-0/15/01-6

ELEVATION (m AHD) BASE OF KAOLINITE AND DAMP ZONES
POTENTIAL WATER SOURCES

Figure 7

Tellus Holdings

Sandy Ridge Project

Mt Walton Waste Facility

Carina Mine

Palaeochannel (inferred)

LEGEND

Potential Exploration Bore Site

Metamorphosed mafic and ultramafic volcanic and intrusive rocks

Granite and gneiss

Alluvial and eolian deposits

Base: State Geological map from Department of Mines and Petroleum

CLIENT: Tellus Holdings

PROJECT: Sandy Ridge

DATE: October 2015

Dwg. No: 454-0/15/01-7
APPENDIX I

BORE COMPLETION DATA
PROJECT: SANDY RIDGE

Bore No: SRMB146

Location: Mt Walton

GDA Coordinates: 219,888 mE 6,637,794 mN

Status: Monitoring bore

Date Commenced: 15/03/2015

Date Completed: 16/03/2015

Drilling Contractor: Wallis Drilling

Drilling Rig: Mantus 300

Depth Drilled: 31 m

Drilling Details: 0 to 7 m, 191 mm air-hammer
7 to 31 m, 152 mm air-core

Casing Details: +0.88 to 0.42 m, 150 mm ND galvanised well cover with lockable lid
+0.73 to 1.27 m, 145 mm OD, 127 mm ID inner steel casing
+0.66 to 24.5 m, 61 mm OD, 55 mm ID, Class 9 uPVC blank casing
24.5 to 30.5 m, 61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots

Pack Interval: 23.3 to 30.5 m graded gravel pack (1.6 – 3.2 mm)
19.3 to 23.3 m bentonite seal
0.2 to 19.3 m backfill
0 to 0.2 m concrete

Reference Point Description: top of galvanised lid

Height of Casing Above Ground: +0.88 m
MONITORING BORE DATA – SRMB146 (continued)

**Reference Point Elevation:** 467.7 m AHD

**Pumping Tests:** Nil

**Static Water Level:** 30.55 m btoc or 437.1 m AHD (6/5/2015)

**Lithology:**

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<th>Lithology</th>
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<td>3</td>
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<td>3</td>
<td>6</td>
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<td>6</td>
<td>7</td>
<td>Silcrete</td>
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<td>7</td>
<td>10</td>
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<td>10</td>
<td>26</td>
<td>Kaolinite</td>
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<td>Granite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NB: Lithology log provided by Terra Search as Rockwater was not onsite for drilling of this hole.
MONITORING BORE DATA – SRMB147

PROJECT: SANDY RIDGE

Bore No: SRMB147

Location: Mt Walton

GDA Coordinates: 219,890 mE 6,638,007 mN

Status: Monitoring bore

Date Commenced: 15/03/2015

Date Completed: 16/03/2015

Drilling Contractor: Wallis Drilling

Drilling Rig: Mantus 300

Depth Drilled: 21 m

Drilling Details: 0 to 8 m, 191 mm air-hammer
8 to 21 m, 152 mm air-core

Casing Details: +0.88 to 0.42 m, 150 mm ND galvanised well cover with lockable lid
+0.86 to 1.14 m, 145 mm OD, 127 mm ID inner steel casing
+0.88 to 14.6 m, 61 mm OD, 55 mm ID, Class 9 uPVC blank casing
14.6 to 20.6 m, 61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots

Pack Interval: 13.5 to 20.6 m graded gravel pack (1.6 – 3.2 mm)
9.5 to 13.5 m bentonite seal
0.2 to 9.5 m backfill
0 to 0.2 m concrete

Reference Point Description: top of galvanised lid

Height of Casing Above Ground: +0.88 m
MONITORING BORE DATA – SRMB147 (continued)

Reference Point Elevation:  466.6 mAHD

Pumping Tests:  Nil

Static Water Level:  20.55 m btoc or 446.0 m AHD (6/5/2015)

Lithology:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2</td>
<td>Sand</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Laterite</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>No sample returns</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>Mottled Zone</td>
</tr>
<tr>
<td>8</td>
<td>21</td>
<td>Kaolinite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NB: Lithology log provided by Terra Search as Rockwater was not onsite for drilling of this hole.
MONITORING BORE DATA – SRMB148

PROJECT: SANDY RIDGE

Bore No: SRMB148

Location: Mt Walton

GDA Coordinates: 219,702 mE 6,637,808 mN

Status: Monitoring bore

Date Commenced: 16/03/2015

Date Completed: 16/03/2015

Drilling Contractor: Wallis Drilling

Drilling Rig: Mantus 300

Depth Drilled: 24 m

Drilling Details: 0 to 10 m, 191 mm air-hammer
10 to 24 m, 152 mm air-core

Casing Details: +1.00 to 0.3 m, 150 mm ND galvanised well cover with lockable lid
+0.90 to 1.1 m, 145 mm OD, 127 mm ID inner steel casing
+0.89 to 18.3 m, 61 mm OD, 55 mm ID, Class 9 uPVC blank casing
18.3 to 24.3 m, 61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots

Pack Interval: 16.3 to 24.3 m graded gravel pack (1.6 – 3.2 mm)
12.3 to 16.3 m bentonite seal
0.2 to 12.3 m backfill
0 to 0.2 m concrete

Reference Point Description: top of galvanised lid

Height of Casing Above Ground: +1.0
Lithology:
NB: Lithology log from 0 to 12 m provided by Terra Search as Rockwater was not onsite for the upper section of this hole.

<table>
<thead>
<tr>
<th>Depth</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Sand</td>
<td>Sandy cover</td>
</tr>
<tr>
<td>2</td>
<td>No sample returns</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Mottled Zone</td>
<td>Iron oxide stained saprolite</td>
</tr>
<tr>
<td>12</td>
<td>Weathered granite</td>
<td>White clay (kaolinite), with minor to major medium to coarse grained angular quartz with trace black minerals (biotite?), moderately hard to hard, trace vugs, @ 18 m slightly damp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End of Hole</td>
</tr>
</tbody>
</table>
PROJECT: SANDY RIDGE

Bore No: SRMB149

Location: Mt Walton

GDA Coordinates: 220,238 mE 6,637,886 mN

Status: Monitoring bore

Date Commenced: 16/03/2015

Date Completed: 16/03/2015

Drilling Contractor: Wallis Drilling

Drilling Rig: Mantus 300

Depth Drilled: 23 m

Drilling Details: 0 to 23 m, 152 mm air-core

Casing Details: +1.15 to 0.15 m, 150 mm ND galvanised well cover with lockable lid
+0.92 to 1.08 m, 145 mm OD, 127 mm ID inner steel casing
+1.06 to 16.9 m, 61 mm OD, 55 mm ID, Class 9 uPVC blank casing
16.9 to 22.9 m, 61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots

Pack Interval: 15.5 to 22.9 m graded gravel pack (1.6 – 3.2 mm)
11.5 to 15.5 m bentonite seal
0.2 to 11.5 m backfill
0 to 0.2 m concrete

Reference Point Description: top of galvanised lid

Height of Casing Above Ground: +1.15 m
Reference Point Elevation: 472.8 mAHD

Pumping Tests: Nil

Static Water Level: Dry or <447.6 m AHD (6/5/2015)

Lithology:

<table>
<thead>
<tr>
<th>Depth From</th>
<th>Depth To</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>Sand</td>
<td>Orange, fine to very coarse, poorly sorted, sub-angular to angular, minor silt, soft</td>
</tr>
<tr>
<td>2</td>
<td>3.5</td>
<td>Sand</td>
<td>Orange, fine to very coarse, poorly sorted, sub-angular to angular, minor silt and lateritic gravel (0.5 to 4 cm) sub-rounded to well-rounded, soft</td>
</tr>
<tr>
<td>3.5</td>
<td>5</td>
<td>Silcrete</td>
<td>Mid brown/cream silicified kaolin, major very coarse sub-angular to very angular quartz, minor orange and red mottling, trace to minor weak fragmented quartz veins, hard, @ 4.5 m core has small vugs</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>Silcrete</td>
<td>Pink silicified kaolin, major very coarse sub-angular to very angular quartz, heavy red mottling, trace to minor weak fragmented quartz veins, hard</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>Silcrete</td>
<td>White silicified kaolin, major very coarse to granular, sub-angular to very angular quartz, hard</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
<td>Silcrete</td>
<td>Red silicified kaolin, very heavy red (hematite) mottling, major very coarse to granular, sub-angular to very angular quartz, hard, minor small vugs</td>
</tr>
<tr>
<td>11</td>
<td>14</td>
<td>Silcrete?</td>
<td>Red silicified kaolin?, completely iron stained, major very coarse to granular, sub-angular to very angular quartz, minor goethite, hard</td>
</tr>
<tr>
<td>14</td>
<td>17</td>
<td>Weathered Granite</td>
<td>White/grey weathered granite with goethite staining, medium to granular, sub-angular to angular grey quartz, traces black/silver micaceous mineral flecks, moderately hard</td>
</tr>
<tr>
<td>17</td>
<td>23</td>
<td>Weathered Granite</td>
<td>Green weathered granite with goethite staining, medium to granular, angular to very angular grey quartz, minor to major black/silver micaceous mineral flecks, moderately hard to hard</td>
</tr>
</tbody>
</table>

End of Hole
MONITORING BORE DATA – SRMB150

PROJECT: SANDY RIDGE

Bore No: SRMB150

Location: Mt Walton

GDA Coordinates: 219,372 mE 6,638,392 mN

Status: Monitoring bore

Date Commenced: 17/03/2015

Date Completed: 17/03/2015

Drilling Contractor: Wallis Drilling

Drilling Rig: Mantus 300

Depth Drilled: 49 m

Drilling Details: 0 to 49 m, 152 mm air-core

Casing Details: +1.07 to 0.13 m, 150 mm ND galvanised well cover with lockable lid
+0.96 to 1.04 m, 145 mm OD, 127 mm ID inner steel casing
+0.92 to 40.0 m, 61 mm OD, 55 mm ID, Class 9 uPVC blank casing
40.0 to 49.0 m, 61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots

Pack Interval: 39.0 to 49.0 m graded gravel pack (1.6 – 3.2 mm)
35.0 to 39.0 m bentonite seal
0.2 to 35.0 m backfill
0 to 0.2 m concrete

Reference Point Description: top of galvanised lid

Height of Casing Above Ground: +1.07 m
MONITORING BORE DATA – SRMB150 (continued)

Reference Point Elevation: 465.0 mAHD

Pumping Tests: Nil

Static Water Level: 36.1 m btoc or 428.9 m AHD (6/5/2015)

Airlift Yield: ~0.03 L/s

Salinity: 6,570 mg/L TDS (calculated from field electrical conductivity)

Lithology:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>Sand</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>Silcrete</td>
</tr>
<tr>
<td>9</td>
<td>18</td>
<td>Clay (kaolinite)</td>
</tr>
<tr>
<td>18</td>
<td>31</td>
<td>Weathered Granite</td>
</tr>
<tr>
<td>31</td>
<td>46</td>
<td>Weathered Granite</td>
</tr>
<tr>
<td>46</td>
<td>49</td>
<td>Granite</td>
</tr>
</tbody>
</table>

Orange, fine to very coarse, poorly sorted, sub-angular to angular, major lateritic gravel up to very large pebbles, soft

White silcrete with major kaolinite, minor to major iron mottling, minor to major fine to very coarse, sub-angular to angular quartz, hard, trace small vugs

White/cream clay (kaolinite) with slight green tinge (chlorite?), minor fine to coarse grained, sub-angular to angular quartz, trace to minor red iron mottling, soft to moderately hard

Cream, major very coarse to granular, very angular to angular quartz with white clay (kaolinite), minor pink feldspars, trace to minor green mottles (chlorite?), moderately hard

Brown, major very coarse to granular, very angular to angular quartz with white clay (kaolinite), major iron staining, minor pink feldspars and green staining (chlorite?), moderately hard, @ 39 m damp

White, relatively fresh granite, hard

End of Hole
MONITORING BORE DATA – SRMB151

PROJECT: SANDY RIDGE

Bore No: SRMB151

Location: Mt Walton

GDA Coordinates: 219,681 mE 6,638,402 mN

Status: Monitoring bore

Date Commenced: 17/03/2015

Date Completed: 17/03/2015

Drilling Contractor: Wallis Drilling

Drilling Rig: Mantus 300

Depth Drilled: 45 m

Drilling Details: 0 to 12 m, 191 mm air-hammer
12 to 45 m, 152 mm air-core

Casing Details: +0.58 to 0.72 m, 150 mm ND galvanised well cover with lockable lid
+0.58 to 1.42 m, 145 mm OD, 127 mm ID inner steel casing
+0.58 to 38.7 m, 61 mm OD, 55 mm ID, Class 9 uPVC blank casing
38.7 to 44.7 m, 61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots

Pack Interval: 32.3 to 44.7 m graded gravel pack (1.6 – 3.2 mm)
28.3 to 32.3 m bentonite seal
0.2 to 28.3 m backfill
0 to 0.2 m concrete

Reference Point Description: top of galvanised lid

Height of Casing Above Ground: +0.58 m
MONITORING BORE DATA – SRMB151 (continued)

Reference Point Elevation: 465.9 mAHD

Pumping Tests: Nil

Static Water Level: 36.65 or 429.2 m AHD (6/5/2015)

Lithology:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Description</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>Silcrete</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>Silcrete</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
<td>Clay (kaolinite)</td>
</tr>
<tr>
<td>27</td>
<td>30</td>
<td>Clay (kaolinite)</td>
</tr>
<tr>
<td>30</td>
<td>36</td>
<td>Weathered granite</td>
</tr>
<tr>
<td>36</td>
<td>39</td>
<td>Weathered granite</td>
</tr>
<tr>
<td>39</td>
<td>42</td>
<td>Weathered granite</td>
</tr>
<tr>
<td>42</td>
<td>45</td>
<td>Granite</td>
</tr>
</tbody>
</table>

End of Hole
MONITORING BORE DATA – SRMB152

PROJECT: SANDY RIDGE

Bore No: SRMB152

Location: Mt Walton

GDA Coordinates: 219,499 mE 6,637,606 mN

Status: Monitoring bore

Date Commenced: 17/03/2015

Date Completed: 17/03/2015

Drilling Contractor: Wallis Drilling

Drilling Rig: Mantus 300

Depth Drilled: 38 m

Drilling Details: 0 to 9 m, 191 mm air-hammer
9 to 38 m, 152 mm air-core

Casing Details: +0.54 to 0.76 m, 150 mm ND galvanised well cover with lockable lid
+0.56 to 1.44 m, 145 mm OD, 127 mm ID inner steel casing
+0.54 to 32.4 m, 61 mm OD, 55 mm ID, Class 9 uPVC blank casing
32.4 to 38.4 m, 61 mm OD, 55 mm ID, Class 9 uPVC machine slotted casing, 1 mm aperture slots

Pack Interval: 31.3 to 38.4 m graded gravel pack (1.6 – 3.2 mm)
27.3 to 31.3 m bentonite seal
0.2 to 27.3 m backfill
0 to 0.2 m concrete

Reference Point Description: top of galvanised lid

Height of Casing Above Ground: +0.54 m
MONITORING BORE DATA – SRMB152 (continued)

Reference Point Elevation: 464.6 m AHD

Pumping Tests: Nil

Static Water Level: 34.35 m or 430.3 m AHD (6/5/2015)

Airlift Yield: ~0.01 L/s

Salinity: 6,030 mg/L TDS (calculated from field electrical conductivity)

Lithology:

<table>
<thead>
<tr>
<th>Depth From</th>
<th>To</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3</td>
<td>Sand</td>
<td>Orange medium to coarse grained moderately sorted sand, minor clay, soft</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>Silcrete</td>
<td>White silcrete, minor lateritic gravel and medium grained angular quartz,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>minor red iron mottling, hard</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>Clay (kaolinite)</td>
<td>White clay (kaolinite) with major pale pink iron mottles and minor yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mottles, minor fine to coarse, sub-angular quartz, soft to moderately hard,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>trace small vugs</td>
</tr>
<tr>
<td>15</td>
<td>27</td>
<td>Weathered Granite</td>
<td>White clay (kaolinite) with major medium to granular, sub-angular quartz,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>moderately hard, trace small vugs</td>
</tr>
<tr>
<td>27</td>
<td>38</td>
<td>Weathered Granite</td>
<td>Cream clay (kaolinite) with slight green tinge (chlorite?), major medium to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>granular, sub-angular quartz, trace black mineral flecks, moderately hard to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>hard, trace small vugs, @ 36 m moist</td>
</tr>
</tbody>
</table>

End of Hole
APPENDIX II

PERMEABILITY TEST PLOTS AND CALCULATIONS
Figure AII-1

Water Level Rise (y, m)

Time (sec)

- 16 March 2015 (18L slug)
- 17 March 2015 (9L slug)

16 March 2015 (18L slug)
17 March 2015 (9L slug)
Figure AII-4

- Water Level Rise (m) vs Time (sec)
- 16 March 2015 (18L slug)
- 17 March 2015 (18L slug)

Date: June 2015

Project: Sandy Ridge Drilling, Permeability Testing
Client: Tellus Holdings

I:\454-0\1501-All-4

Slug Tests
and Water Source Recovery

SRMB149 FALLING HEAD TESTS
Figure AII-5

- Time (sec):
  - 0
  - 1,000
  - 2,000
  - 3,000

- Water Level Rise (y, m):
  - 0.1
  - 1
  - 10

17 March 2015 (18L slug)
18 March 2015 (18L slug)

I:\454-0\1501\All-5

SRMB150 FALLING HEAD TESTS

Client: Tellus Holdings
Project: Sandy Ridge Drying Permeability Testing and Potential Water Sources Report

Dwg No: 454-01501-All-5
Date: June 2015

Figure AII-5
Figure AII-5

Water Level Rise (y, m)

0.1 1.0 10.0

Time (sec)

0 1,000 2,000 3,000

17 March 2015 (18L slug)
18 March 2015 (18L slug)

I:\454-0\Grapher\Slug Tests\SRMB150 Falling Head.grf
Figure AII-7

0 1,000 2,000 3,000 4,000
Time (sec)

0.0 0.1 1.0 10.0
Water Level Rise (y, m)

18 March Test 1 (18L slug)
18 March Test 2 (18L slug)

I:\454-0\Grapher\Slug Tests\SRMB152 Falling Head.grf
### Bore SRMB146 (Falling Head Test 1)

(Using Oosterbaan & Nijland (1994) Method For Holes Above Water Table)

Using early-time data

<table>
<thead>
<tr>
<th>Formula:</th>
<th>Enter (Overwrite)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( K = 1.15 \times r^* \frac{\log (h_o + r/2) - \log (h_t + r/2)}{t - t_o} )</td>
<td>Variables: (0.076) (Hole radius, m) (h_o = 1.340) (Head at (t_o), m) (h_t = 1.230) (Head at (t), m) (t_o = 0.00) (Time at (h_o) in secs) (t = 2000) (Time at (h_t) in secs) (t_o - t = 2000.0)</td>
</tr>
</tbody>
</table>

| Term 1 | 0.0874 | Term 4 | 0.038 |
| Term 2 | 0.19234922 |
| Term 3 | 0.10311925 |

\( K = 1.579 \times 10^{-6} \text{ m/sec} \)

0.136 m/d

### Bore SRMB146 (Falling Head Test 2)

(Using Oosterbaan & Nijland (1994) Method For Holes Above Water Table)

Using early-time data

<table>
<thead>
<tr>
<th>Formula:</th>
<th>Enter (Overwrite)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( K = 1.15 \times r^* \frac{\log (h_o + r/2) - \log (h_t + r/2)}{t - t_o} )</td>
<td>Variables: (0.076) (Hole radius, m) (h_o = 0.471) (Head at (t_o), m) (h_t = 0.436) (Head at (t), m) (t_o = 0.00) (Time at (h_o) in secs) (t = 2000) (Time at (h_t) in secs) (t_o - t = 2000.0)</td>
</tr>
</tbody>
</table>

| Term 1 | 0.0874 | Term 4 | 0.038 |
| Term 2 | -0.2932822 |
| Term 3 | -0.3242217 |

\( K = 1.352 \times 10^{-6} \text{ m/sec} \)

0.117 m/d
Bore SRMB147 (Falling Head Test 1)

(Using Oosterbaan & Nijland (1994) Method For Holes Above Water Table)

Using early-time data

Formula:

\[ K = 1.15 \times r^* \times \frac{\log (h_o + r/2) - \log (h_i + r/2)}{(t - t_o)} \]

Enter (Overwrite)

Variables:
- \( r^* \) (Hole radius, m)
- \( h_o = 0.203 \) (Head at \( t_o \), m)
- \( h_i = 0.162 \) (Head at \( t_m \), m)
- \( t_o = 628.00 \) (Time at \( h_o \) in secs)
- \( t_m = 1284 \) (Time at \( h_i \) in secs)
- \( t - t_o = 656.0 \)

Term 1 = 0.0874
Term 2 = -0.617983
Term 3 = -0.69897

Term 4 = 0.038

\[ K = 1.079 \times 10^{-5} \text{ m/sec} \]

\[ 0.932 \text{ m/d} \]
Bore SRMB148 (Falling Head Test 1)

(Using Oosterbaan & Nijland (1994) Method For Holes Above Water Table)

Using early-time data

Formula:

\[ K = 1.15 * r^* \left( \log \left( h_o + r/2 \right) - \log \left( h_t + r/2 \right) \right) / (t - t_o) \]

Enter (Overwrite)

Variables:

- \( h_o = 0.870 \) (Head at \( t_o \) in m)
- \( h_t = 0.460 \) (Head at \( t_m \) in m)
- \( t_o = 0.00 \) (Time at \( h_o \) in secs)
- \( t = 2000 \) (Time at \( h_t \) in secs)

\( t_o - t = 2000.0 \)

\[
\begin{align*}
\text{Term 1} & \quad 0.0874 & \quad \text{Term 4} & \quad 0.038 \\
\text{Term 2} & \quad -0.041914151 & \\
\text{Term 3} & \quad -0.302770657 & \\
\end{align*}
\]

\[ K = 1.140 \times 10^{-5} \text{ m/sec} \]

\[ 0.985 \text{ m/d} \]
### Bore SRMB149 (Falling Head Test 1)

**Using early-time data**

**Formula:**

\[
K = 1.15 r^* \left( \log \left( \frac{h_o + r}{2} \right) - \log \left( \frac{h_t + r}{2} \right) \right) / (t - t_o)
\]

**Variables:**

- \( h_o = 0.700 \) (Head at \( t_o \), m)
- \( h_t = 0.545 \) (Head at \( t \), m)
- \( t_o = 0.00 \) (Time at \( h_o \) in secs)
- \( t = 2000 \) (Time at \( h_t \) in secs)
- \( t_o - t = 2000.0 \)

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0874</td>
</tr>
<tr>
<td>2</td>
<td>-0.13194364</td>
</tr>
<tr>
<td>3</td>
<td>-0.23433145</td>
</tr>
</tbody>
</table>

\[
K = 4.474 \times 10^{-6} \text{ m/sec}
\]

\[
0.387 \text{ m/d}
\]

### Bore SRMB149 (Falling Head Test 2)

**Using early-time data**

**Formula:**

\[
K = 1.15 r^* \left( \log \left( \frac{h_o + r}{2} \right) - \log \left( \frac{h_t + r}{2} \right) \right) / (t - t_o)
\]

**Variables:**

- \( h_o = 0.670 \) (Head at \( t_o \), m)
- \( h_t = 0.583 \) (Head at \( t \), m)
- \( t_o = 0.00 \) (Time at \( h_o \) in secs)
- \( t = 2000 \) (Time at \( h_t \) in secs)
- \( t_o - t = 2000.0 \)

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0874</td>
</tr>
<tr>
<td>2</td>
<td>-0.14996674</td>
</tr>
<tr>
<td>3</td>
<td>-0.2069084</td>
</tr>
</tbody>
</table>

\[
K = 2.488 \times 10^{-6} \text{ m/sec}
\]

\[
0.215 \text{ m/d}
\]
## TEST 1

<table>
<thead>
<tr>
<th>k</th>
<th>r</th>
<th>c</th>
<th>ln Re/rw</th>
<th>Lw/rw</th>
<th>Lw/w</th>
<th>y0</th>
<th>y1</th>
<th>t1</th>
<th>t</th>
<th>Lw</th>
<th>Le</th>
<th>rw</th>
<th>lc</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0007</td>
<td>2</td>
<td>9.0</td>
<td>0.0001</td>
<td>0.0010</td>
<td>1.00E-07 m/sec</td>
<td>Hydraulic Conductivity</td>
<td>0.0092 m/day</td>
<td>Transmissivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## TEST 2

<table>
<thead>
<tr>
<th>k</th>
<th>r</th>
<th>c</th>
<th>ln Re/rw</th>
<th>Lw/rw</th>
<th>Lw/w</th>
<th>y0</th>
<th>y1</th>
<th>t1</th>
<th>t</th>
<th>Lw</th>
<th>Le</th>
<th>rw</th>
<th>lc</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0007</td>
<td>2</td>
<td>9.0</td>
<td>0.0001</td>
<td>0.0007</td>
<td>8.04E-08 m/sec</td>
<td>Hydraulic Conductivity</td>
<td>0.0069 m/day</td>
<td>Transmissivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST 1

\[
k = \frac{r_c^2 \ln \left( \frac{R_e}{r_w} \right)}{2L_w} \times \frac{1}{t} \ln \left( \frac{y_0}{y_t} \right)
\]

Where
- \( L_w = 6.0 \) (Slotted Length)
- \( r_w = 0.076 \) (Hole Radius)
- \( r_c = 0.026 \) (Casing Radius)
- \( L_w = 8.2 \) (Depth from SWL to Base of Slots)
- \( L_w/r_w = 78.95 \)
- \( A = 3.8 \) (Parameter from graph)
- \( B = 0.6 \) (Parameter from graph)
- \( C = 3.6 \) (Parameter from graph)
- \( y_0 = 3.300 \) (Head at \( t = 0 \))
- \( y_t = 2.609 \) (Head at time \( t \))
- \( t = 100 \) (Time \( t - \) secs)

\[
\ln \left( \frac{R_e}{r_w} \right) = 1.1 + 3.6^{-1} \left( \frac{L_w}{r_w} \right)
\]

\[
\ln \left( \frac{L_w}{r_w} \right) = 4.68 + 3.6^{-1} \left( \frac{L_w}{r_w} \right)
\]

\[
\ln \left( \frac{L_w}{r_w} \right) = 0.235 + 0.046
\]

\[
k = 0.0007 \times 3.5609 \times 0.0100 \times 0.2350
\]

\[
k = 0.0002 \times 6.0
\]

\[
k = 4.71E-07 \text{ m/sec}
\]

\[
k = 0.0407 \text{ m/day}
\]

\[
k = 0.3323 \text{ m}^2/\text{day}
\]
### Mt Walton

**Bore SRMB152 Falling-Head Test Calculations (Logger Data)**

(Using Bouwer and Rice's Method (1989))

#### TEST 1

\[
k = \frac{r_c^2 \ln \left( \frac{R_e}{r_w} \right)}{2L_e} \times \frac{1}{t \ln \left( \frac{y_o}{y_t} \right)}
\]

Where:
- \( L_e = 6.0 \) (Slotted Length)
- \( r_w = 0.076 \) (Hole Radius)
- \( r_c = 0.026 \) (Casing Radius)
- \( \ln \left( \frac{R_e}{r_w} \right) = 1.1 + \frac{C}{L_e} \)
- \( L_e / r_w = 78.95 \)

(Assumes base is impervious)

\[
A = 3.8 \quad \text{(Parameter from graph)}
\]
\[
B = 0.6 \quad \text{(Parameter from graph)}
\]
\[
C = 3.6 \quad \text{(Parameter from graph)}
\]

\[
y_o = 2.006 \quad \text{(Head at } t = 0) \quad \text{use early time}
\]
\[
y_t = 1.187 \quad \text{(Head at } t \text{)} \quad \text{use early time}
\]
\[
t = 180 \quad \text{(Time } t \text{- secs)}
\]

\[
\ln \left( \frac{R_e}{r_w} \right) = 1.1 + \frac{3.6}{4.01} \times 78.95 = 3.13
\]

\[
k = 0.0007 \times 3.136 \times 0.0056 \times 0.5247 = 0.00007 \times 0.0056 \times 6.0 = 0.00002 \times 0.0056 \times 6.0 = 5.05 \times 10^{-7} \text{ m/sec}
\]

Hydraulic Conductivity = 0.0437 m/day

Transmissivity = 0.1885 m²/day

#### TEST 2

\[
k = \frac{r_c^2 \ln \left( \frac{R_e}{r_w} \right)}{2L_e} \times \frac{1}{t \ln \left( \frac{y_o}{y_t} \right)}
\]

Where:
- \( L_e = 6.0 \) (Slotted Length)
- \( r_w = 0.076 \) (Hole Radius)
- \( r_c = 0.026 \) (Casing Radius)
- \( \ln \left( \frac{R_e}{r_w} \right) = 1.1 + \frac{C}{L_e} \)
- \( L_e / r_w = 78.95 \)

(Assumes base is impervious)

\[
A = 3.8 \quad \text{(Parameter from graph)}
\]
\[
B = 0.6 \quad \text{(Parameter from graph)}
\]
\[
C = 3.6 \quad \text{(Parameter from graph)}
\]

\[
y_o = 1.981 \quad \text{(Head at } t = 0) \quad \text{use early time}
\]
\[
y_t = 1.116 \quad \text{(Head at } t \text{)} \quad \text{use early time}
\]
\[
t = 200 \quad \text{(Time } t \text{- secs)}
\]

\[
\ln \left( \frac{R_e}{r_w} \right) = 1.1 + \frac{3.6}{4.01} \times 78.95 = 3.13
\]

\[
k = 0.0007 \times 3.1257 \times 0.0050 \times 0.5739 = 0.00007 \times 0.0050 \times 6.0 = 0.00002 \times 0.0050 \times 6.0 = 5.05 \times 10^{-7} \text{ m/sec}
\]

Hydraulic Conductivity = 0.0437 m/day

Transmissivity = 0.1885 m²/day
Hydrogeology Assessment
1 BACKGROUND

Tellus Holdings Limited (Tellus) is proposing to develop a kaolin mine at its Sandy Ridge project at Mount Walton, approximately 140 km north-west of Kalgoorlie. It plans to utilise mined-out pits for a complementary storage and waste-disposal business.

A water supply of 180,000 kL per annum (~495 kL/d or about 6 L/s) will be required when mining and mineral processing is ramped-up to full production. Initially a much smaller volume would be required. It is planned to obtain the water required from the Carina iron ore mine owned by Polaris Metals Pty Ltd, located 12 km south-west of Sandy Ridge.

The Environmental Scoping Document for the Sandy Ridge project requires Tellus to:

- Assess the impacts on water quality of sourcing water from the Carina mine over 25 years; and
- Assess the viability of using the Carina mine as a water source for 25 years.

This memorandum addresses the above items which concern the sustainability of the water source.

2 VIABILITY OF USING CARINA MINE PIT AS WATER SOURCE

The Carina mine pit intersects vuggy goethitic iron ore that has moderate to high permeability.

A review of dewatering progress by Rockwater in 2014 showed that pumping from the pit increased from about 1,200 to 1,400 kL/d in 2011 to about 2,250 kL/d in March 2014. A numerical model was calibrated to historical pumpage and water levels, and was run to predict future pumping requirements; rates of up to 3,000 kL/d were indicated to be needed.
The water pumped from the pit is currently stored in a series of turkeys nest dams and is used for dust suppression, ore processing and camp use. An unknown quantity is evaporated or lost as seepage back into the ground.

The same numerical model was used to estimate steady-state groundwater inflows for several pit water levels, to be used as one component of the post-mining pit water balance. The water balance is used to assess the viability and potential impact of using water from the pit for the Sandy Ridge water supply.

Post-mining, the water in the pit will recover until groundwater inflows plus rainfall accumulation balance evaporation losses. As the water level rises, groundwater inflows decrease and the area for evaporation increases. The following were also assumed:

- Rainfall accumulation = 80% of the average annual rainfall for Southern Cross, falling within the perimeter bunds;
- Evaporation is dam evaporation for Southern Cross, given in Luke, Burke and O’Brien, 1988, reduced by 20% to allow for the lower rate of evaporation for saline water; and
- Water areas at each elevation were measured from contours from the planned pit design.

The water balance for several pit water levels is given in the table below.

<table>
<thead>
<tr>
<th>Water Level (m AHD)</th>
<th>Area (m²)</th>
<th>Inflows (kL/d)</th>
<th>Evap (kL/d)</th>
<th>Rainfall (kL/d)</th>
<th>Balance (kL/d)</th>
<th>extraction (kL/d)</th>
<th>New Balance (kL/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>412</td>
<td>274,590</td>
<td>0</td>
<td>1,211</td>
<td>332</td>
<td>-879</td>
<td>495</td>
<td>-1,374</td>
</tr>
<tr>
<td>370</td>
<td>149,040</td>
<td>564</td>
<td>657</td>
<td>332</td>
<td>239</td>
<td>495</td>
<td>-256</td>
</tr>
<tr>
<td>350</td>
<td>93,150</td>
<td>707</td>
<td>411</td>
<td>332</td>
<td>628</td>
<td>495</td>
<td>133</td>
</tr>
<tr>
<td>300</td>
<td>12,150</td>
<td>979</td>
<td>54</td>
<td>332</td>
<td>1,257</td>
<td>495</td>
<td>762</td>
</tr>
</tbody>
</table>

Without extraction, the balance (at 0 kL/d) indicates that the pit water level will stabilise at about 379 m AHD. Extraction at the maximum rate needed (495 kL/d) would lower the pit water level until it stabilises at about 357 m AHD. Even without allowing for the water available from pit storage, this indicates that the water supply is sustainable.

3 POTENTIAL IMPACT ON WATER QUALITY

The water in the Carina pit has salinity of about 33,000 mg/L TDS. The original static water level was at about 412 m AHD.

The water balance above shows that even without groundwater extraction, the post-mining pit water level will be about 33 m below the original static water level, and so the pit will become a permanent groundwater sink, with evaporation losses exceeding rainfall accumulation. Consequently, the salinity of the pit water will gradually increase.
Pumping water from the pit will lower the pit water level and so will reduce both evaporation losses and the rate of salinity increase. This positive impact will be enhanced by removing water from the pit that is more saline than the groundwater inflows.

Water in the pit is alkaline (pH 7.5 to 8.0) and there are no indications that lowering water levels in the pit will have any impact on the alkalinity of the water.

4 CONCLUSIONS

Our assessment is that water from the Carina mine pit should be a suitable water source for the Sandy Ridge project, and that a water supply of up to 495 kL/d will be easily sustainable.

Post-mining, the pit will become a permanent sink, resulting in a gradual increase in the salinity of the pit water, and there will be no potential for the pit water to flow back into surrounding rocks. Pumping water from the pit will have the beneficial impact of reducing the rate of salinity rise.

Dated: 4 February 2016 Rockwater Pty Ltd

P H Wharton
Principal

REFERENCE